TRANSIENT CHARACTERIZATION OF A PROPYLENE LOOP HEAT PIPE DURING START-UP AND SHUT-DOWN

José I. Rodriguez, Mike Pauken and Arthur Na-Nakornpanom
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California, USA 91109

Abstract

A technology demonstration Loop Heat Pipe (LHP) has been tested extensively at the Jet Propulsion Laboratory in support of the implementation of this technology on NASA's Earth Observing System Tropospheric Emission Spectrometer (TES) instrument. This cryogenic instrument is being developed at the Jet Propulsion Laboratory for NASA. In this paper, we report on the transient characterization testing results for a propylene LHP.

In applications, when a component of large mass on an instrument or spacecraft is attached to a LHP evaporator, there is a concern that the LHP will not start when power is applied to the component until a significant temperature overshoot from the equilibrium temperature is developed. In some space applications, this may be a problem because the maximum allowable flight temperatures (AFTs) may be exceeded. Similarly, when power is removed from the component, there is a concern that the LHP will continue to operate, for some extended period of time, due to the sensible heat available from the large mass. Its important to understand the LHP behavior in such a situation in order to make reliable component temperature predictions for non-operating scenarios and to prevent component temperatures from dropping below the minimum non-operating AFT limits.

A test program was developed to characterize the start-up and shut-down transient behavior of a propylene LHP with a large mass attached to the evaporator. The LHP was tested over the expected operational temperature and power range during ground test operations and in flight for the TES instrument. In addition, a start-up heater was implemented on the LHP evaporator and tested under similar conditions. Transient results show the magnitude of the overshoot with and without the start-up heater. Recommendations are made for future applications and additional research on this topic.

José I. Rodriguez
Jet Propulsion Laboratory
MS 157-316, 4800 Oak Grove Dr.
Pasadena, CA 91109-8099

Phone:(818) 354-0799
Fax (818) 393-4206
email: jose.i.rodriguez@jpl.nasa.gov